STATE OF NEW MEXICO

NUTRIENT REDUCTION STRATEGY

FOR PROTECTING AND IMPROVING WATER QUALITY

2012

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Executive Summary

The State of New Mexico currently has a narrative nutrient criterion, which states, "*Plant nutrients from other than natural causes shall not be present in concentrations that will produce undesirable aquatic life or result in a dominance of nuisance species in surface waters of the state*" (Subsection E of 20.6.4.13 NMAC). New Mexico's narrative nutrient criterion can be challenging to assess as the relationships between nutrient levels and impairment of designated uses are not easily defined and distinguishing nutrients from "other than natural causes" is difficult. Despite these challenges, New Mexico has been employing a holistic approach to the universal problem of excess nutrients that (1) emphasizes threshold development for certain nutrient-related water quality variables (e.g., total nitrogen (TN), total phosphorus (TP), dissolved oxygen, chlorophyll *a*, etc.) to ensure effective and appropriate assessment of the narrative nutrient criterion and (2) encourages and promotes near-term nutrient load reductions in impaired watersheds through TMDL development and implementation.

In 2002, SWQB developed a nutrient assessment protocol to assist in meeting the nutrient reduction challenge. While this protocol was applied and used to develop 100% non-point source TMDLs, it lacked impairment thresholds and quantitative endpoints necessary to develop TMDLs with both point and non-point sources. Therefore, in 2004, SWQB with the assistance of EPA and the U.S. Geological Survey (USGS) refined the protocol. Threshold values for cause (TN and TP) and response variables (dissolved oxygen, pH, and chlorophyll *a*) were used in a weight-of-evidence assessment to determine impairment and to translate the narrative nutrient criterion into quantified endpoints. SWQB adopted a weight-of-evidence approach that incorporates both cause and response variables to conduct a more robust assessment and account for diverse lotic systems and dynamic nutrient cycling.

Application of the weight-of-evidence nutrient assessment protocol has resulted in the following:

I. Sixty-one (61) assessment units identified as impaired for nutrients, representing 962 stream miles, and 13% of all impairments in New Mexico.

II. Twenty-nine (29) EPA-approved nutrient TMDLs that have also been successfully incorporated into the State's Water Quality Management Plan.

III. Eight (8) wastewater treatment plants with nutrient (TN and TP) effluent limits in NPDES permits issued by EPA Region 6. Four (4) more facilities are anticipated to have nutrient effluent limits in the near future as a result of recently approved nutrient TMDLs. The limits in these permits are generally considered to be very low limits, among the lowest in the region.

As documented above, New Mexico has undertaken an effective approach to address nutrient impairments through the weight-of-evidence assessment of our narrative nutrient criterion, development of nitrogen and phosphorous TMDLs for impaired water bodies, and implementation of TMDL targets through the NPDES permitting process. As such, SWQB is not currently pursuing adoption of numeric nutrient water quality standards. Without additional federal funds, SWQB would be obligated to shift all of its resources currently allocated to nutrient assessment and associated TMDLs to begin development of numeric nutrient criteria. We continue to believe that EPA should provide flexibility to states by allowing nutrient impairments to be addressed through effective programs that are within the state's financial and resource capabilities. This is especially necessary in a state such as New Mexico that receives the minimum allocation of Section 106 monies.

The following table summarizes and prioritizes SWQB's goals for developing numeric nutrient thresholds for New Mexico's waters. The time frame is the anticipated completion date and assumes that the identified resource needs have been met. Resources are categorized into three major groups: time, money, and people.

Table 1. SWQB goals for developing numeric nutrient impairment thresholds

Water Body Type	Goal/Implementation Plan	Resources Needed	Time Frame
Lakes and Reservoirs	Evaluate and revise numeric nutrient impairment thresholds (TN and TP) based on new information. - Finalize the nutrient assessment protocol (AP) for lakes and reservoirs.	Time	2012
Rivers	Change-point analysis to link TN and TP concentrations to a biological response (benthic macroinvertebrates and/or stream metabolism). - Identify numeric nutrient impairment thresholds for TN and TP - Incorporate nutrient thresholds into weight-of-evidence approach to determining impairment. - Develop nutrient AP for non-wadeable rivers	Time and money	2013
Streams	Change-point analysis to link TN and TP concentrations to a biological response (benthic macroinvertebrates). - Evaluate and revise numeric nutrient thresholds (TN and TP) based on new information. - Refine nutrient AP for wadeable, perennial streams.	Time and money	2014
Wetlands	Complete all elements required for a monitoring and assessment program for wetlands. On-going monitoring of wetlands to compile a nutrient dataset suitable for analysis.	People, time, and money	2016
All	Review and update *Nutrient Reduction Strategy (this plan)*	Time	Every 2 years

Definition of the Problem

Phosphorus and nitrogen generally drive the productivity of algae and macrophytes in aquatic ecosystems, are regarded as the primary limiting nutrients in freshwaters, and are essential for proper functioning of ecosystems; however, excess nutrients cause conditions unfavorable for the proper functioning of aquatic ecosystems. Rain, overland runoff, groundwater, drainage networks, and industrial and residential waste effluents transport nutrients to receiving water bodies. Once present in the water they can drive enhanced growth and reproduction of algae, macrophytes, and microorganisms either in the water column or on the bottom substrate. Nuisance levels of algae and other aquatic vegetation, such as macrophytes, can develop rapidly in response to nutrient enrichment when other factors (e.g., light, temperature, firm substrate, etc.) are not limiting. Unfortunately, the magnitude of nutrient concentration that constitutes an "excess" is difficult to determine and varies by waterbody.

The relationship between nutrient enrichment and nuisance algal growth in stream systems has been well documented in the literature (Welch 1992; Van Nieuwenhuyse and Jones 1996; Dodds et al. 1997; Chetelat et al. 1999). Nutrient impaired waters can cause problems that range from annoyances to serious health concerns (Dodds and Welch 2000). Documented impacts that can be attributed to nutrient impairment include:

- Taste and odor problems in drinking water supplies.
- Increased treatment required for drinking water.
- Human health problems, such as blue baby syndrome and non-Hodgkin lymphoma.
- Adverse ecological effects, such as large diel swings in dissolved oxygen that can stress (or kill) aquatic life or reduction of habitat that can be used by other organisms.
- Harmful algal blooms[*].

Excess nutrients in aquatic systems can have large impacts, as noted above. Nutrient pollution can clearly lead to degraded water quality and non-attainment of the Federal Clean Water Act goal "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters" [CWA §101(a)] and the New Mexico Water Quality Act implied goal "to protect the public health, welfare, and to enhance the quality of water" (§§ 74-6-1 *et seq.*, NMSA 1978).

[*] New Mexico has two types of toxic algae, *Lyngbya* sp. and *Prymnesium* sp. Nutrients are reported to play a significant role in *Prymnesium* blooms (Johansson and Graneli 1999a, 1999b; Johansson 2000; Graneli and Johansson 2001; Legrand, et al. 2001; Graneli and Johansson 2003a, 2003b; Skovgaard, et al. 2003). It seems likely that nutrients play a role in *Lyngbya* blooms as well, although this has yet to be documented.

Overview of Nutrient Criteria Development in New Mexico

Nutrient criteria development plans have served as road maps for outlining the process states use to develop numeric nutrient criteria; however the schedule and milestones within the plans need to be updated periodically to accurately reflect any progress the state has made. Related to this need, EPA established guidelines for Program Activity Measures (PAMs) WQ-1c and WQ-26 which relate to a phased criteria development process with the long-term goal of developing numeric nutrient criteria for total nitrogen (TN) and total phosphorus (TP) for all water body types in the state. Within this goal, EPA has requested that states provide target and completion dates for the following activities for each water body type (refer to **Table 11**):

1. Planning for criteria development
2. Collection of information and data
3. Analysis of information and data
4. Proposal of criteria (related to measure WQ-1c)
5. Adoption of criteria into the water quality standards (related to measure WQ-26)

Planning for Criteria Development (Activity #1)

Prioritization of water bodies and sites is necessary given limited resources allotted to meet the water quality objectives of the SWQB and EPA. SWQB will prioritize waters for the development of nutrient threshold values according to the water body type as follows:

(1) streams (2) lakes and reservoirs (3) rivers, and (4) wetlands.

Streams were selected as the highest priority as they represent the majority of the waters assessed in New Mexico. Since a large body of data exists for reservoirs and they are a highly valued resource, they have been selected as the second priority. SWQB has a fairly large dataset of concurrently collected TN, TP, chlorophyll *a* and secchi depth, which will be supplemented with data from other entities. The dataset for rivers has significant gaps, particularly for response variables, so this water body type will be addressed third. Over the past couple of years, SWQB has been compiling a dataset that could be used to supplement existing data and develop threshold values for nutrient assessment of rivers. SWQB recently began a wetlands program, so the process of collecting wetlands data is in its infancy. It will likely take a number of years to compile a dataset sufficient to address this water body type. Therefore, nutrient threshold development for wetlands was given the lowest priority.

Monitoring of the various water body types will be on-going to develop datasets for use in classification as well as threshold development and refinement. Monitoring will serve the dual purposes of filling in data gaps for nutrient variables and providing additional information on reference and/or expected conditions.

Collection of Information and Data (Activity #2)

According to New Mexico's 2012-2014 Integrated CWA §303(d)/ §305(b) Report (NMED/ SWQB 2012), *nutrient/eutrophication biological indicators* is the third leading cause of impairment of designated uses in New Mexico's streams and rivers and is the fifth leading cause of impairment in lakes and reservoirs behind dissolved oxygen, which may be related to excessive nutrients. With recognition of the pervasiveness and severity of nutrient-related problems, the need to accurately monitor and assess nutrient impairment and develop effective TMDLs for impaired waters is clear.

Development and refinement of nutrient threshold values is an iterative process, therefore continued, on-going monitoring in all applicable water body types will serve multiple purposes including enhancing or developing datasets for threshold development/refinement, filling in data gaps, gathering information for classification purposes, and providing additional support for reference and/or expected conditions.

Analysis of Information and Data (Activity #3)

Wadeable, perennial streams

New Mexico's narrative nutrient criterion can be challenging to assess as the relationships between nutrient levels and impairment of designated uses are not well defined, and distinguishing nutrients from "other than natural causes" is difficult. The Surface Water Quality Bureau (SWQB) nutrient criteria/assessment efforts have largely focused on wadeable, perennial streams as they represent the majority of assessed surface waters. In a series of steps between 2002 and 2007 SWQB developed and refined the assessment approach for these waters.

Nutrient threshold development for streams has taken place in three steps, thus far. First, EPA compiled nutrient data from the national nutrient dataset, divided it by water body type, grouped it into nutrient ecoregions, and calculated the 25th percentiles for each aggregate and Level III ecoregion (**Table 2**). EPA published the recommended water quality criteria for Total Nitrogen (TN) and Total Phosphorus (TP) to help states and tribes reduce problems associated with excess nutrients in waterbodies in specific areas of the country (USEPA 2000a). Refinement of the recommended draft ecoregional nutrient criteria was conducted in 2004 by Evan Hornig, a USGS employee assisting states in EPA Region 6 with development of nutrient criteria. Hornig used regional nutrient data from EPA's Storage and Retrieval System (STORET), the U.S. Geological Survey (USGS), and the Surface Water Quality Bureau (SWQB) to create a dataset specific to New Mexico. The revised TN and TP threshold values were calculated based on EPA procedures (USEPA 2000b) but utilized the median value (50th percentile) for each Level III ecoregion in New Mexico (**Table 3**), rather than EPA's preferred 25th percentile.

Table 2. EPA draft ecoregion nutrient thresholds for streams (mg/L), calculated using the **25th percentile** and EPA procedures

	Southern Rockies	AZ/NM Mountains	AZ/NM Plateau	Chihuahuan Desert	Southwest Tablelands
TN	0.04	0.12	0.085	0.543	0.26
TP	0.006	0.011	0.015	0.018	0.025

Table 3. Revised ecoregion nutrient thresholds for streams (mg/L), calculated using regional data, the **50th percentile** and EPA procedures

	Southern Rockies	AZ/NM Mountains	AZ/NM Plateau	Chihuahuan Desert	Southwest Tablelands
TN	0.30	0.32	0.42	0.64	0.54
TP	0.025	0.020	0.070	0.062	0.025

In 2007, a third round of analysis was conducted by SWQB to refine nutrient threshold values for streams based on the ecoregion *and* designated aquatic life use. For this round of analysis, nutrient data (TP, total Kjeldahl nitrogen, and nitrate plus nitrite) from the National Nutrient Dataset (1990-1997) were combined with Archival STORET data for 1998, and the SWQB nutrient dataset (1999-2006) resulting in almost 7,000 data points for each parameter.

Once the dataset was compiled, the data were divided by waterbody type, removing all rivers, reservoirs, lakes, wastewater treatment effluent, and playas. Level III and IV Omernik ecoregions (Griffith et al. 2006) were assigned to all stream sites using GIS coverages and the station's latitude and longitude. Aquatic life use (i.e., coldwater, warmwater, and transitional) were also assigned to all stream sites according to the designated use applied in New Mexico's water quality standards. Sites with "limited aquatic life" designations were removed from the dataset as they generally represent waters with ephemeral or intermittent flow, naturally occurring rapid environmental changes, high turbidity, fluctuating temperatures, low dissolved oxygen content or unique chemical characteristics. The 50th percentiles (i.e., medians) were calculated for TN and TP according to the ecoregion/aquatic life use group (**Table 4**). The refined threshold values were incorporated into the 2008 Nutrient Assessment Protocol for Streams.

Table 4. Nutrient thresholds for streams (mg/L) based on ecoregion <u>*and*</u> aquatic life use, using regional data and the **50th percentile** (NMED/SWQB 2008).

	Southern Rockies		**AZ/NM Mountains**		**AZ/NM Plateau**		**Chihuahuan Desert**	**Southwest Tablelands**		
ALU	*CW*	*T/WW (volcanic)*	*CW*	*T/WW*	*CW*	*T/WW*	*T/WW*	*CW*	*T*	*WW*
TN	0.25	0.25	0.25	0.29	0.28	0.48	0.53	0.25	0.38	0.45
TP	0.02	0.02 (0.05)	0.02	0.05	0.04	0.09	0.04	0.02	0.03	0.03

ALU = aquatic life use
CW = coldwater aquatic life
T = transitional (both cold and warmwater aquatic life)
WW = warmwater aquatic life

Data will continue to be collected by SWQB/MAS and used to refine the threshold values for streams. In future analyses, New Mexico will utilize an effects-based approach, such as change-point analysis, that more closely links water quality targets with attainment of specific designated uses. Once the threshold values have been thoroughly tested they may be proposed for adoption into the New Mexico Water Quality Standards, although SWQB currently has no plans to do so.

Lakes and Reservoirs

Similar to EPA's approach for deriving criteria, SWQB calculated percentiles for its initial analysis in 2009; however in future analyses, New Mexico will utilize an effects-based approach that more closely links water quality targets with attainment of specific designated uses. Nutrient data from Archival STORET (1989-1998) were combined with the SWQB nutrient dataset (1999-2007) resulting in 406 sample events from 107 sites on 78 lakes and reservoirs. This dataset includes the 25 lakes sampled by SWQB in 2006 and 2007 as part of the CWA 104(b)(3) Nutrient Criteria Development Phase 3 Grant designed to fill data gaps.

An *a priori* classification system based on lake characteristics and designated uses was used for the preliminary analysis. In this manner, thresholds would vary according to major differences in lake functionality. This system separated natural lakes from man-made reservoirs and then further divided the natural lakes into high-altitude lakes or sinkholes. The natural lakes dataset is very small, consisting of only 21 sample events from 17 lakes, thus limiting the types of statistical analysis that could be performed. A number of classification systems were used for reservoirs including surface acreage, drainage basin size, maximum depth, elevation, ecoregion, and designated uses (e.g., domestic water supply, coldwater aquatic life, etc.).

Simple correlations were examined as a preliminary analysis of the relationship between cause and response variables (**Table 5**). In addition to the chemical and physical data, phytoplankton and diatom community composition data were compiled and the proportion of cyanobacteria (i.e., blue-green algae) was determined for each sample event with phytoplankton data. Cyanobacteria are a group of phytoplankton that generally represent a higher proportion of biomass under nutrient-rich conditions. The strongest correlations in the reservoir data were observed during the growing season between chlorophyll *a*, total nitrogen, and percent cyanobacteria. Slightly weaker correlations were also observed for chlorophyll *a*, percent cyanobacteria, total phosphorus, and secchi depth. This suggests that a suite of indicators will be useful in determining impairment of New Mexico lakes and reservoirs including transparency (secchi depth), causal variables (TN and TP), and algal metrics (chlorophyll *a* and percent cyanobacteria). Dissolved oxygen (DO) may also be used as a secondary or supporting indicator because, although the vertical DO gradient is strongly influenced by stratification, it also shows some response to nutrient concentrations and algal biomass.

Table 5. Correlations of cause and response variables in New Mexico's lakes and reservoirs

	Secchi Depth	Spec. Cond.	Alka-linity	TSS	nL TKN	nL Nitrate Nitrite	nL TP	nL TN	Hard-ness	Chloro-phyll_a	% depth < DO criteria	Ave. DO of top 3m
TSS	-0.160	0.495	0.104									
nL TKN	-0.159	0.311	0.363	0.050								
nL Nitrate Nitrite	-0.222	-0.107	-0.219	0.0003	-0.151							
nL TP	-0.261	0.059	0.197	0.025	0.547	-0.035						
nL TN	-0.191	0.304	0.340	0.057	0.988	-0.018	0.563					
Hard-ness	-0.154	0.931	0.145	0.335	0.226	-0.112	0.030	0.214				
Chloride	-0.074	0.865	0.072	0.409	0.288	-0.088	0.107	0.294	0.817			
Chloro-phyll_a	**- 0.349**	-0.032	0.237	0.027	0.423	-0.105	**0.379**	**0.43**1	-0.069			
% depth <DO criteria	-0.070	-0.247	-0.146	-0.117	-0.294	0.101	-0.101	-0.264	-0.145	0.120		
Ave. DO of top 3m	0.073	-0.064	0.090	-0.076	0.151	-0.072	-0.012	0.131	-0.100	0.028	-0.495	
%Cyano-bacteria	-0.151	-0.111	0.3128	-0.1867	0.494	-0.181	**0.415**	**0.493**	-0.124	**0.446**	-0.014	0.303

In 2011, analysis of the lake nutrient dataset was conducted by Thad Scott and Brian Haggard from the University of Arkansas. They used change-point and regression tree analyses on environmental and biological data from New Mexico lakes and reservoirs to identify TP and TN thresholds that were correlated with common biological response variables such as chlorophyll *a*, secchi depth, and percent cyanobacteria. Median TP and TN concentrations in New Mexico lakes and reservoirs were correlated with median secchi depth, median euphotic zone thickness, and median chlorophyll *a* concentration (**Figure 1 and Figure 2**). In addition, TP or TN concentrations were always the best predictors of these biological response variables in all but one analysis. The thresholds reported from this study provide quantitative evidence for the link between nutrient concentrations and commonly measured biological response data in the state's lakes and reservoirs.

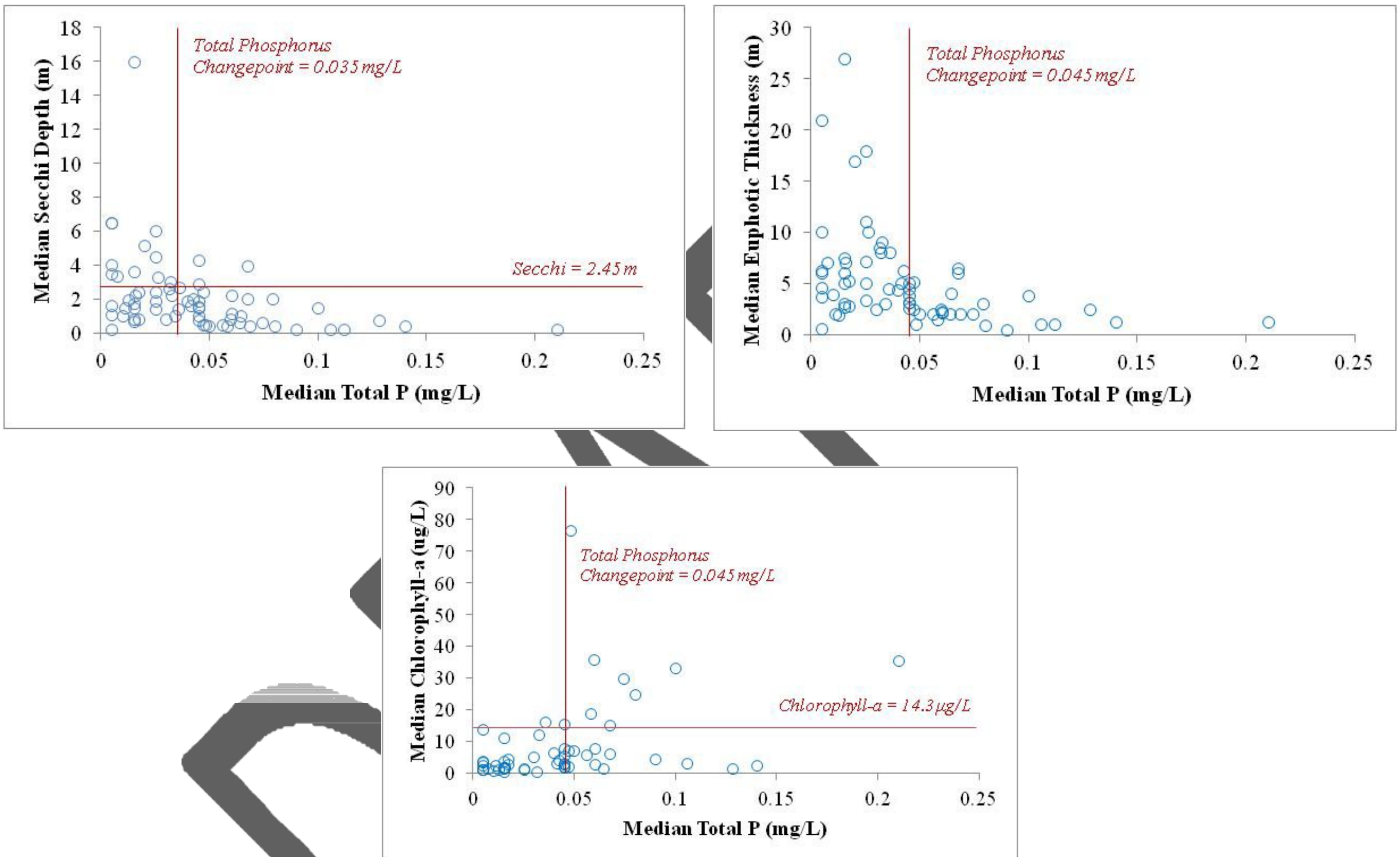

Figure 1. Results of change-point analysis on median TP values for all lakes and reservoirs (Scott and Haggard 2011)

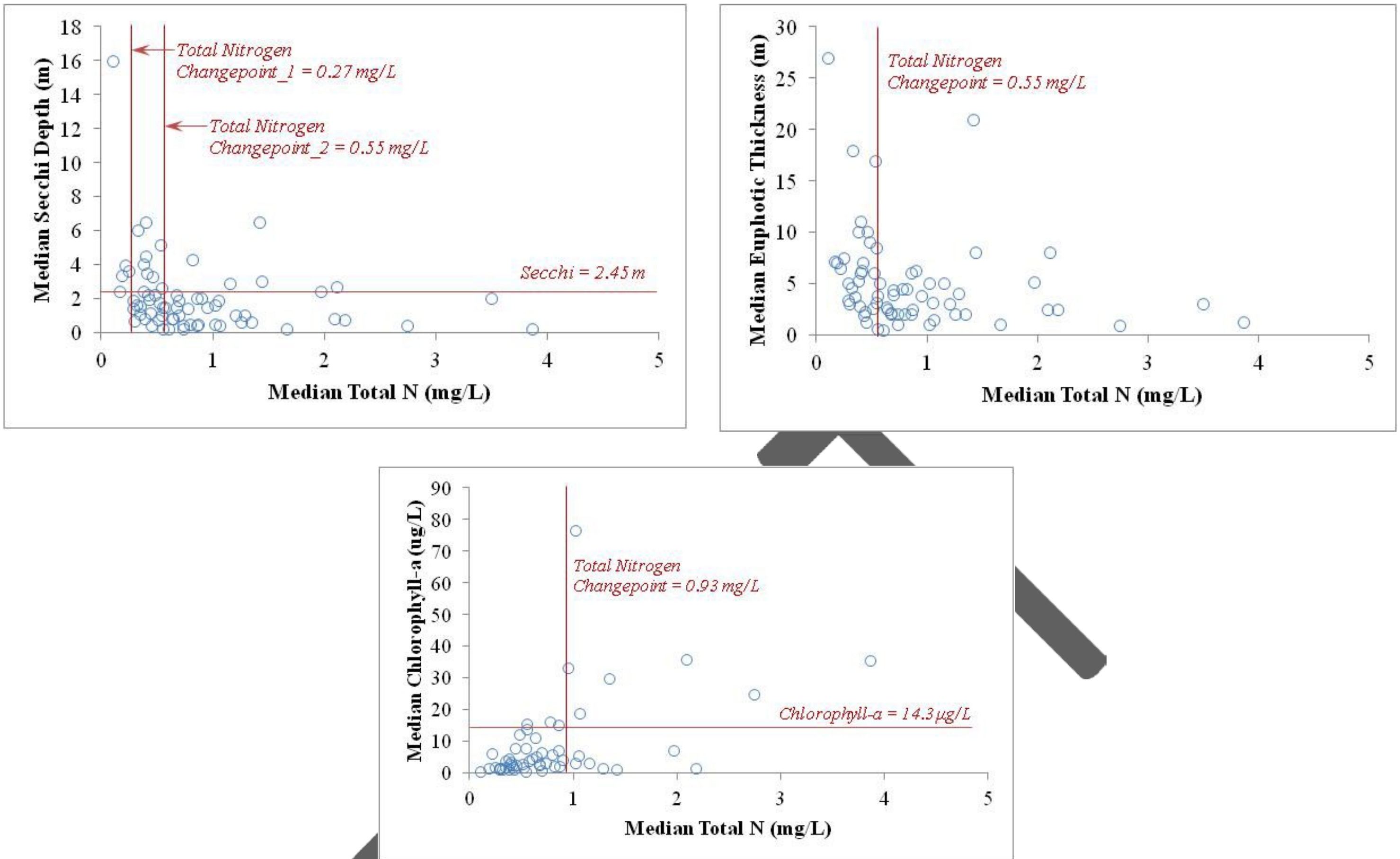

Figure 2. Results of change-point analysis on median TN values for all lakes and reservoirs (Scott and Haggard 2011)

SWQB is in the process of developing and testing a nutrient assessment protocol for lakes based on the recent change-point and regression tree analyses. The thresholds derived from these analyses will be compared to percentiles and literature-derived values to determine a final threshold value or range of values for use in a weight-of-evidence approach to nutrient assessment.

Non-wadeable Rivers

SWQB is distinguishing rivers from streams by defining systems that cannot be monitored effectively with the biological and habitat methods developed for wadeable streams. These rivers also generally meet the Simon and Lyons (1995) definition of great rivers as those having drainage areas greater than 2,300 square miles (mi^2). There are many systems is in New Mexico that meet the great river definition but are suitable to wadeable streams monitoring methods due to the arid nature of the region. The systems included in the "rivers" water body type are:

1. The San Juan River from below Navajo Reservoir to the Colorado border near Four Corners
2. The Rio Grande in New Mexico

3. The Pecos River from below Sumner Reservoir to the Texas border
4. The Rio Chama from below El Vado Reservoir to the Rio Grande
5. The Gila River from below Mogollon Creek to the Arizona border near Virden, NM
6. The Canadian River from below the confluence with the Cimarron River to the Texas border
7. The Animas River from the Colorado border to its confluence with the San Juan River

The only river listed above that does not meet the great rivers definition is the Rio Chama, which has a drainage area of only 880 mi^2 below El Vado Reservoir. However, the flow of the Rio Chama is augmented with water diverted from the San Juan River drainage via the San Juan/Chama Project. The Rio Chama reaches a drainage area of 2300 mi^2 below Abiquiu Reservoir.

Similar to EPA's approach for deriving criteria (**Table 6**), SWQB calculated percentiles for its initial analysis in 2009. Nutrient data from Archival STORET (1989-1998) were combined with river data from the SWQB water quality database (1999-2007). This dataset included the 43 river sites sampled by SWQB as part of the CWA 104(b)(3) Nutrient Criteria Development Phase 3 Grant designed to fill data gaps. USGS data from 25 river sites were also added to the dataset.

Table 6. EPA recommended river criteria for aggregate nutrient ecoregions in New Mexico

Parameter	Western Forested Mountains	Xeric West	Great Plains Grass and Shrublands	South Central Cultivated Great Plains
TP (mg/L)	0.010	0.022	0.023	0.067
TN (mg/L)	0.12	0.38	0.56	0.88

The special challenges of setting nutrient-related targets and the unique conditions in New Mexico (i.e., limited number of rivers and associated data) have led SWQB to a different approach from other criteria derivation methods. Rather than deriving one set of targets to be applied to all rivers, SWQB is developing site-specific targets that vary according to the water body and, if the river crosses ecoregional boundaries, ecoregion.

In addition to cause and response variables, water body classification variables were defined for each sample event or station. Classification variables included designated uses (e.g. coldwater aquatic life, warmwater aquatic life, domestic water supply), elevation, and ecoregion. The 25th, 50th, and 75th percentiles of various nutrient-related parameters were calculated (**Table 7**). SWQB's preliminary analysis suggested that a suite of indicators will be useful in determining impairment of New Mexico rivers including both causal (TP and TN) and response variables (diel DO fluctuation and chlorophyll *a*).

Table 7. Percentiles of nutrient-related indicators for New Mexico's rivers

	Total Phosphorus (mg/L)			Total Kjehldal N (mg/L)			Nitrate + Nitrite (mg/L)			Diel DO Fluctuation (mg/L)		
percentiles	***25th***	***50th***	***75th***	***25th***	***50th***	***75th***	***25th***	***50th***	***75th***	***25th***	***50th***	***75th***
Animas River	0.020	0.040	0.110	0.175	0.230	0.390	0.050	0.085	0.198	1.47	1.68	1.93
Canadian River	0.015	0.030	0.052	0.300	0.400	0.658	0.025	0.050	0.085	0.875	1.42	1.65
Gila River	0.040	0.070	0.140	0.195	0.310	0.560	0.128	0.255	0.466	ND	ND	ND
Pecos River (Salt Crk to Sumner Rsv)	0.010	0.020	0.070	0.160	0.260	0.353	0.025	0.025	0.100	1.39	1.47	1.71
Pecos River (TX border to Salt Crk)	0.015	0.040	0.090	0.480	0.700	1.00	0.050	0.180	0.600	ND	ND	ND
Rio Chama (Rio Grande to El Vado)	0.024	0.060	0.100	0.200	0.300	0.400	0.025	0.050	0.050	0.850	1.13	1.26
Rio Grande (Hwy 528 in ABQ to CO)	0.040	0.090	0.230	0.300	0.440	0.710	0.050	0.110	0.280	0.835	1.22	2.22
Rio Grande (TX to Hwy 528 in ABQ)	0.090	0.200	0.320	0.470	0.660	0.930	0.130	0.300	0.720	0.998	1.18	1.70
San Juan River	0.030	0.093	0.280	0.200	0.320	0.560	0.050	0.150	0.260	1.73	1.87	1.99

NOTE: N = nitrogen DO = dissolved oxygen ND = no data

In 2011, Thad Scott and Brian Haggard from the University of Arkansas used change-point and regression tree analyses on environmental and biological data from New Mexico rivers to identify TP and TN thresholds that were correlated with common biological response variables (Scott and Haggard 2011). TP and TN concentrations were correlated with benthic chlorophyll *a* (**Figure 3**) and the Trophic Diatom Index across all New Mexico rivers; however TP concentrations were always the best predictors of these biological response variables. TN concentrations were also useful in predicting biological responses, but these relationships were much weaker than TP and other environmental variables such as temperature, dissolved oxygen, and turbidity were actually stronger predictors in the Categorical and Regression Tree (CART) model. The thresholds identified in this analysis are similar to others published in the scientific literature (Scott and Haggard 2011). These results provide a quantitative framework that link specific nutrient concentrations to biological outcomes in New Mexico rivers, and will be used as guidance in setting nutrient impairment thresholds in non-wadeable rivers of New Mexico.

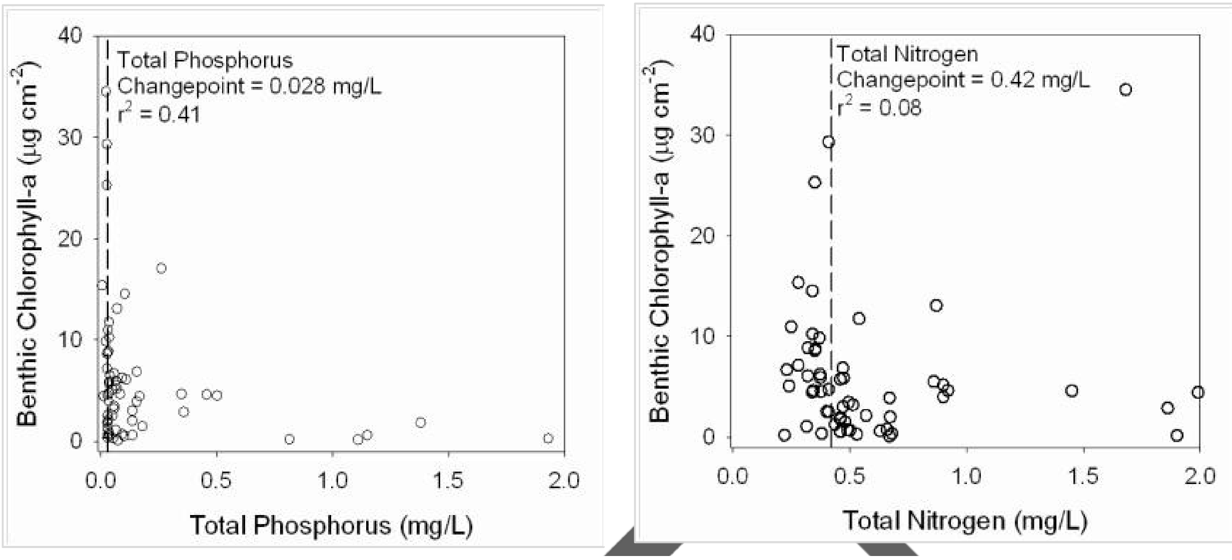

Figure 3. Results of change-point analysis on TP/TN and benthic chlorophyll-a using data from all non-wadeable rivers in New Mexico (Scott and Haggard 2011)

SWQB is in the process of developing a nutrient assessment protocol for rivers, but is awaiting further data collection and analyses. Due to the relatively small amount of data in the analysis (n = 67 samples that had nutrient and benthic chlorophyll-a data), the thresholds derived from the change-point and regression tree analyses will be compared to percentiles and literature-derived values to determine a final threshold value or range of values for use in a weight-of-evidence approach to nutrient assessments of rivers.

Wetlands

SWQB recently began a wetlands program, so the process of collecting wetlands data has just begun. It will likely take a number of years (possibly up to a decade) to compile a dataset sufficient to address this water body type.

Proposal and Adoption of Nutrient Criteria in WQS (Activity #4 and #5)

Data will continue to be collected by SWQB/MAS and used to develop and/or refine the nutrient threshold values, as described above, for each applicable water body type in New Mexico. Threshold values for nutrient variables are and will be used as numeric translators of the narrative standard and incorporated into the weight-of-evidence nutrient assessment protocol. After the threshold values have been thoroughly tested and refined, and depending on the approach that is currently being pursued by other states and accepted by EPA, they may be proposed for adoption into the New Mexico WQS. If adoption of nutrient criteria is undertaken in the future it will likely follow the approach of states such as Maine and Ohio (MDEP 2012; OEPA 2011) in which both cause and response variables are incorporated into proposed criteria.

The NM Water Quality Control Commission (WQCC) must approve proposed criteria before they can be incorporated into *State of New Mexico Standards for Interstate and Intrastate*

Surface Waters (20.6.4 NMAC). A public review and comment period and a public hearing are required. Upon completion of the public review process, if substantive changes are not required, the WQCC can approve the final proposal, accepting the final rule for state purposes. This whole process typically takes six to twelve months. After the revised WQS are published through the state records office, they are sent to EPA Region 6 for review and approval.

At the present time, New Mexico is <u>not</u> pursuing adoption of numeric nutrient criteria into the State's WQS.

Summary of New Mexico's Nutrient Reduction Strategy

Development of numeric criteria was stimulated by the U.S. Environmental Protection Agency's *National Strategy for Development of Regional Nutrient Criteria* (USEPA 1998) with the long-term goal being that states complete the task of developing numeric nutrient criteria for total nitrogen (N) and total phosphorus (P) for all water body types in the state. In the decade since then little progress has been made on numeric nutrient criteria nationally and alternative approaches have been attempted by a number of states and EPA continues to refine its approach. Most recently an EPA memo entitled, *Working in Partnership with States to Address Phosphorus and Nitrogen Pollution through Use of a Framework for State Nutrient Reductions* (Stoner 2011), provided eight recommended elements of a state framework. The eighth element, "Develop work plan and schedule for numeric nutrient criteria development" establishes a goal for states to complete development of numeric N and P criteria for at least one class of waters within three to five years. In addition, EPA has indicated in the *FY12 National Water Program Guidance* that it places a high priority on states addressing excess nutrients through adoption of numeric water quality criteria for nitrogen and phosphorous in streams, rivers, lakes and reservoirs. EPA has added performance measures (WQ-1a and WQ-26) which track state progress toward adoption of numeric nutrient water quality standards.

From 2003 to 2008 EPA, through the §104(b)(3) program, funded the New Mexico Environment Department's Surface Water Quality Bureau (SWQB) to develop nutrient criteria and assessment protocols. This work and the progress that was made are documented in SWQB's *Nutrient Criteria Development Plan* which EPA has reviewed and approved (NMED/SWQB, 2008). However, with the loss of this funding SWQB has only been able to make minimal progress on developing additional assessment approaches (e.g., for large rivers) or for advancing existing assessment approaches toward full criteria development (e.g., for wadeable streams). In fact we have not even had the available staff time to revise and update the plan since early 2008. That is not to say that this work has been for naught; the products developed to date are presently being used by SWQB to implement core Clean Water Act (CWA) activities related to documenting impaired waters on the §303(d) list and developing Total Maximum Daily Load (TMDL) planning documents for these waters, which ultimately result in discharge limits in EPA-issued NPDES permits. The funding EPA provided is directly responsible for the tangible results New Mexico has made in identifying and addressing nutrient impaired water bodies including:

> ***Impaired Waters – §303(d) list – 61 assessment units; 962.22 stream miles and 4,323 lake acres; 14% of impairments***

New Mexico has identified 61 assessment units as impaired for nutrients, representing 962 stream miles, 4,323 lake acres, and 14% of all impairments. Nutrients are the third leading cause of impairment, after temperature and *E. coli*, in streams and rivers of New Mexico and the fifth leading cause of impairment in lakes and reservoirs behind dissolved oxygen, which may be related to nutrients. It is worth noting that this represents a significant increase from 2004 when only 151.5 miles, equating to approximately 17 assessment units, were listed. This is due to the application of New Mexico's weight-of-evidence assessment protocol which was first implemented for the 2006-2008 Integrated Report. As New Mexico has not yet cycled through all watersheds with our current assessment approach this number will continue to grow – significantly with the next integrated report and then more slowly.

TMDLs – 29 completed to date; 1 pending approval

New Mexico has a total of 29 TMDLs completed for plant nutrients. Four of these were completed in 2001-2002 the rest have been completed since the adoption of our new assessment protocol (i.e. after the 2006 listing cycle). All of these have been approved by the Water Quality Control Commission and, as such, incorporated into the State Water Quality Management Plan. One TMDL has gone through the public participation process and has not yet been appoved by the NM Water Quality Control Commission. In addition, based on assessments from recent water quality surveys, 6 more nutrient TMDLs may be written with wasteload allocations including, but not limited to Santa Fe River, Rio Pueblo de Taos, Gallinas River, Glorieta Creek, Pecos River, and San Juan River.

Permits with effluent limits – 8 currently; 4 more anticipated in the near future

Currently eight facilities have nutrient effluent limits (TP and TN) in NPDES permits issued by EPA R6 – Taos Ski Valley, Ruidoso/Ruidoso Downs, Aztec, Mora, Mora National Fish Hatchery, Cuba, Jemez Springs, and Chama. Four more facilities – Angle Fire, Springer, Los Ojos State Fish Hatchery, and Tucumcari – are anticipated to have permit limits in the very near future due to recently approved nutrient TMDLs.

As documented above, New Mexico has undertaken an effective approach to address nutrient impairments through assessment of our narrative nutrient standard, development of nitrogen and phosphorous TMDLs for impaired water bodies, and implementation of TMDL targets through the NPDES permitting process. As such, SWQB is making strong progress toward reducing nitrogen and phosphorus pollution by setting priorities on a watershed basis and establishing nutrient reduction targets (EPA performance measure WQ-26); however SWQB is not currently addressing EPA performance measure WQ-01a that tracks state progress toward adoption of numeric nutrient water quality standards. Without additional federal funds, SWQB would be obligated to shift all of its resources currently allocated to nutrient assessment and associated TMDLs to begin development of numeric nutrient criteria. We continue to believe that EPA should provide flexibility to states by allowing nutrient impairments to be addressed through effective programs that are within the state's financial and resource capabilities. This is especially necessary in a state such as New Mexico that receives the minimum allocation of Section 106 monies.

New Mexico's Nutrient Assessment

New Mexico's narrative nutrient criterion can be challenging to assess as the relationships between nutrient levels and impairment of designated uses are not well defined, and distinguishing nutrients from "other than natural causes" is difficult. According to Dodds and Welch (2000), it is important to incorporate response variables into the assessment because ambient water column nutrient concentrations alone, "…cannot indicate supply because large biomass of primary producers may have a very high nutrient demand and render inorganic nutrient concentrations low or below detection." Therefore, SWQB uses a weight-of-evidence approach to conduct a more robust assessment and to account for diverse systems and dynamic nutrient cycling. In this approach, both cause (TN and TP) and response variables (e.g., DO, pH, chlorophyll *a*, etc.) are evaluated to determine impairment.

If a stream reach is determined to be impaired based on the nutrient assessment protocol, Total Maximum Daily Load (TMDL) development must be scheduled. If there are NPDES permittees discharging into the impaired receiving water, the TMDL will generally be written to address both TN and TP because many receiving streams in New Mexico are co-limiting, meaning that overall loads of both TN and TP must be reduced to adequately address nutrient impairment. If SWQB has evidence that only one nutrient is causing the impairment, the TMDL will focus on that particular nutrient.

Wadeable, perennial streams (actively used since 2004)

The first nutrient assessment protocol for streams was developed in 2002. This protocol was applied and used to develop 100% non-point source TMDLs; however it lacked impairment thresholds and quantifiable endpoints necessary to develop TMDLs with both point and non-point sources. In a series of analyses from 2002 and 2011 SWQB developed and refined it assessment approach for these waters..

A two-tiered approach to nutrient assessment is utilized for streams mainly because the large number of stream segments in New Mexico and the need to prioritize data collection efforts and resources. The two levels of assessment are used in sequential order to determine if there is excessive nutrient enrichment. The Level I assessment is a screening level assessment that is more qualitative and based on a review of available data, including on-site qualitative observations (e.g. percent algal cover) and in-stream quantitative measurements (e.g. TN and TP concentrations). If a Level I assessment indicates potential nutrient enrichment, a Level II assessment is used to provide a quantitative evaluation. The Level II assessment is based on measurements exceeding both the numeric nutrient threshold values and indicators of excessive primary production (i.e., large dissolved oxygen (DO) and pH fluctuation, and/or high chlorophyll *a* concentration) that demonstrate an unhealthy biological community (**Figure 4** and **Figure 5**). If and only if both occur is the reach considered to be impaired.

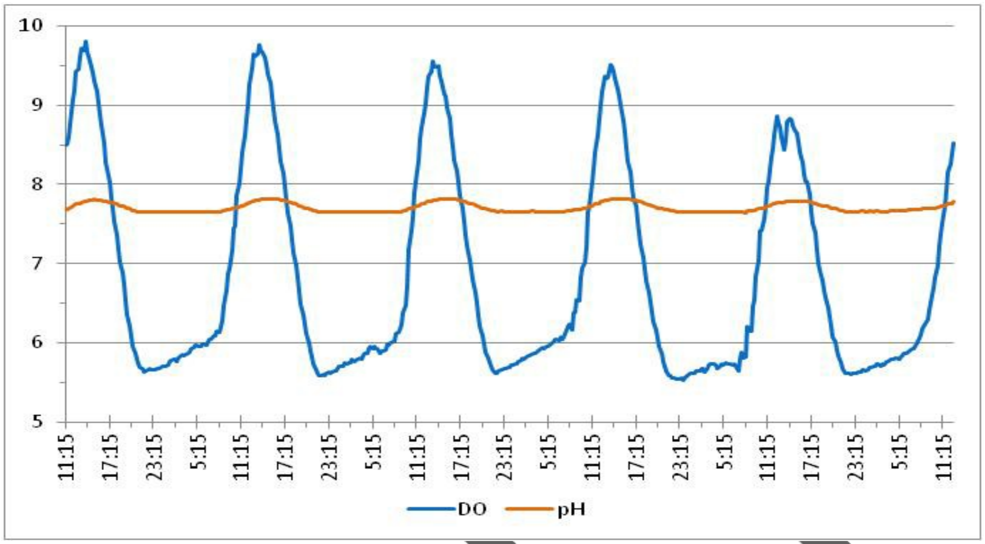

Figure 4. Nutrient influenced diel patterns in dissolved oxygen in La Plata River at La Plata, NM (September 16 – 21, 2010)

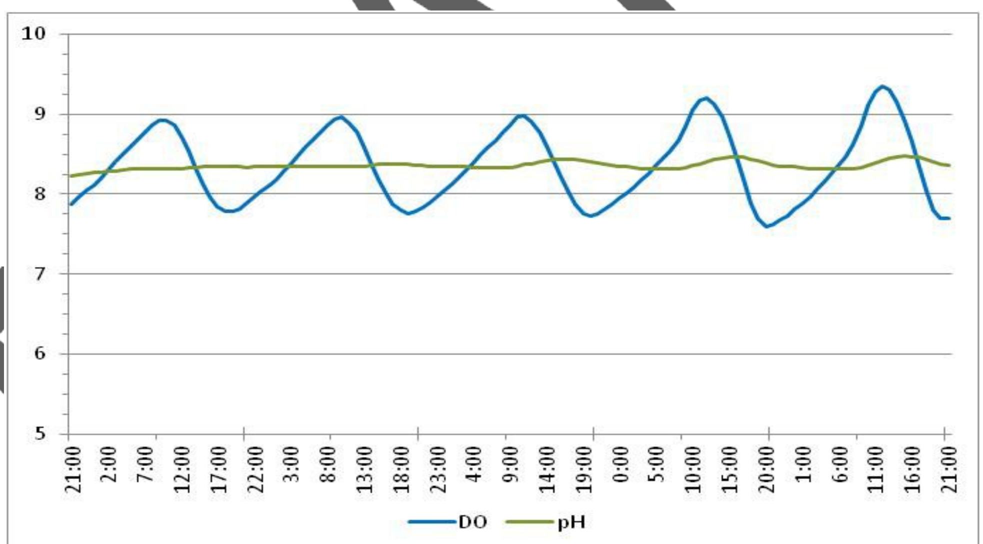

Figure 5. "Normal" diel patterns in dissolved oxygen and pH in the Animas River above Estes Arroyo (September 23 – 28, 2010)

Level I assessments are conducted at each water quality station; however, if a stream reach was previously listed as impaired for nutrients, a Level II assessment must be performed. Both the Level I and Level II assessments use a weight-of-evidence approach that evaluates various conditions in the stream and utilizes both stressor (nitrogen and phosphorus) and response (DO, pH, algal biomass) variables in order to conduct a more robust assessment and account for diverse lotic systems and dynamic nutrient cycling.

The following indicators are used in assessment:

Level I Observations

- Percent algae coverage
- Periphyton growth (thickness)
- Presence of anoxic layer

Level I Measurements

- Dissolved oxygen (% saturation) and pH
- TN and TP concentrations

Level II Measurements

- Continuous dissolved oxygen and pH datasets (sonde data)
- Dissolved oxygen and pH grab data
- TN and TP concentrations
- Periphyton chlorophyll *a* (µg/cm^2)

Dissolved oxygen and pH thresholds are based on designated uses of an assessment unit, as indicated in section 20.6.4.900 of the *State of New Mexico Standards for Interstate and Intrastate Surface Waters* (NMWQCC 2011). TN and TP thresholds are based on New Mexico's nutrient criteria development process as discussed in the *Analysis of Information and Data* section above.

For chlorophyll *a*, the 90th to 99th percentile of data from best available sites was used to calculate impairment thresholds for each ecoregion (**Table 8**). If a sample falls within the ranges presented in Table 8, SWQB will list the AU under category "5C – Additional information needed before scheduling TMDL development." The listing will be changed to Not Supporting (Category 5A) if a second chlorophyll *a* sample within a 5-year period confirms the impairment.

Table 8. Chlorophyll *a* Level III Ecoregional Threshold Values in µg/cm^2

21-Southern Rockies	20/22-AZ/NM Plateau	23-AZ/NM Mountains	24/79-Chihuahuan Desert	25/26-SW Tablelands
3.9 – 5.5	7.4 – 7.8	5.8 – 11.0	16.5 – 17.5	8.2 – 14.0

Note: Since the number of samples used to calculate the thresholds is relatively small for each ecoregion, the 90th to 99th percentile range is used for threshold values.

For most streams, indicators are compared to thresholds values derived from water quality standards, SWQB analyses, or published literature. However, if the assessor feels that the established thresholds are not appropriate for the class of stream being assessed, a reference site approach may be used. A suitable reference reach will be surveyed and indicators from the study reach will be compared to those of the reference reach rather than the established thresholds. This is to account for streams that may have naturally high productivity because of regional geology, flow regime, or other natural causes. For more information on the assessment process, please refer to *Nutrient Assessment Protocol for Wadeable Perennial Streams* (NMED/SWQB 2011; Appendix D).

Lakes and Reservoirs (in development)

Similar to the stream assessment, nutrient assessments for lakes and reservoirs will use a weight-of-evidence approach that evaluates various conditions and utilizes both stressor (TN and TP) and response (DO, Secchi depth, chlorophyll *a*, and % cyanobacteria) variables in order to conduct a robust assessment and account for diverse lentic systems and dynamic nutrient cycling. Assessments will be conducted on data collected at the station located in the deepest portion of the water body. Currently, the indicators are divided into four groups: nutrient concentrations (TP and TN), transparency (Secchi depth), phytoplankton (phytoplankton chlorophyll *a* and percent cyanobacteria), and dissolved oxygen. A single threshold value or range of values may be used for assessing the various indicators. Once the threshold values for the various indicators have been validated, a lake will be determined to be not supporting due to nutrient impairment if both stressor and response indicators exceed their respective threshold value.

Non-wadeable Rivers (in development)

Similar to the other nutrient assessments, nutrient assessments for large, non-wadeable rivers will use a weight-of-evidence approach that evaluates various conditions and utilizes both stressor (nitrogen and phosphorus) and response (DO, algal biomass) variables in order to conduct a more robust assessment and account for diverse lotic systems and dynamic nutrient cycling. Currently, the indicators are divided into three groups: nutrient concentrations (TP and TN), dissolved oxygen (DO flux, DO concentration, and DO saturation), and algal biomass (benthic chlorophyll *a* and percent algal cover). Data are being collected and analyzed to determine if a diatom nutrient index is correlated to nutrient impairment in New Mexico rivers. If the diatom community shifts significantly in response to nutrient enrichment the Trophic Diatom Index will be added as an indicator in the weight-of-evidence assessment. Once the threshold values for the various indicators have been validated, a river will be determined to be not supporting due to nutrient impairment if both stressor and response indicators exceed their respective threshold value.

Wetlands (not started)

SWQB recently began a wetlands program, so the process of collecting wetlands data has just begun. It will likely take a number of years (possibly up to a decade) to compile a dataset sufficient to develop nutrient impairment thresholds for assessment purposes.

Nutrient TMDL Development

Numeric nutrient thresholds are necessary to establish targets for TMDLs and allocate wasteload allocations for point sources, to develop water quality-based permit limits and source control plans, and to support designated uses within the watershed.

If a water body is determined to be impaired based on the nutrient assessment protocol, Total Maximum Daily Load (TMDL) development must be scheduled (**Table 9**). The task of developing quantitative load models to implement the narrative water quality standard is not straightforward for obvious reasons. The State, in order to meet legal mandates, has to conduct

TMDL development for nutrients on the basis of best information available at the time. This has been done with EPA's encouragement and approval typically by using the quantitative, ecoregion-based, threshold values developed by NMED for the causal variables (TN and TP) as TMDL targets. The intent of TMDL targets for phosphorus and nitrogen is to control undesirable aquatic life, such as the excessive growth of attached algae and higher aquatic plants, which can result from the introduction of these plant nutrients into streams. This goal is codified into the water quality standards [NMAC 20.6.4.13(E)] and serves to protect the existing and attainable uses of surface waters of the state.

In developing TMDLs, especially those involving a wasteload allocation (i.e., NPDES permit), determination of the limiting nutrient(s) should continue to be considered. Nitrogen and phosphorus are often "co-limiting" in New Mexico's wadeable streams and thus both pollutants ultimately require regulation to prevent impairment. If a single nutrient can be definitively established as "limiting" then regulation of that single nutrient can be considered; however great caution must be exercised to ensure that addressing only one parameter (e.g., TP or TN) will not set off secondary problems such as a shift in algae community composition that leads to a dominance of blue-green algae.

Table 9. Nutrient TMDL development and wasteload allocations in New Mexico

Date	Waterbodies with Nutrient TMDLs *(waterbodies in BOLD have a Wasteload Allocation)*	Effluent Limits?	Phased Limits?	Implementation Options	# of Nutrient TMDLs
2002	Mangas Creek, Centerfire Creek, Canyon Creek, San Francisco River	none	-	-	4
2005	**Rio Hondo (Taos Ski Valley)**	**Yes**	no	none	1
2005	**Animas River**	**Yes**	no	none	1
2006	**Rio Ruidoso**	**Yes**	no	none	1
2007	**Rio Puerco**, Rio Moquino, Bluewater Creek	**Yes**	no	Seasonal limits; Zero discharge; Meet wasteload allocation	3
2007	**Mora River**, Little Coyote Creek	**Yes**	no	Meet wasteload allocation; Cluster systems	2
2009	**Jemez River**, Rio de las Vacas, Rito Penas Negras	**Yes**	no	none	3
2009	Oak Creek	none	-	-	1
2010	**Cienguilla Creek**, **Cimarron River (x2)**, Moreno Creek, Ponil Creek, Rayado Creek, Sixmile Creek	**Yes**	**Yes**	none	6
2011	**Rio Chamita**, **Rio Chama**, Rio Tusas	**Yes**	**Yes**	Seasonal limits	3

Date	Waterbodies with Nutrient TMDLs *(waterbodies in BOLD have a Wasteload Allocation)*	Effluent Limits?	Phased Limits?	Implementation Options	# of Nutrient TMDLs
2011	Middle Ponil Creek	none	-	-	1
2011	**Pajarito Creek**, Canadian River, Una de Gato Creek (x2)	**Yes**	**Yes**	Year-round Phase 1 limits; Zero discharge, 100% reuse; Seasonal limits	3
pending	***Raton Creek***	***Yes***	***Yes***	Year-round Phase 1 limits; Zero discharge, 100% reuse; Seasonal limits	*1*

Implementing Nutrient Control Strategies

Every calculation based on experience elsewhere, fails in NM —
Lew Wallace, Territorial Governor of NM, 1881

Much of the work that has been done nationally to address the nutrient problem is focused on resolving issues in huge watersheds such as the Chesapeake Bay or the Gulf of Mexico. These nutrient reduction strategies often talk about problems of cumulative impacts that are manifested as impairments far downstream of the actual point of discharge. In contrast, the problem in NM is quite different. The point of impact in most impairments currently on the §303(d) list are immediately downstream of a single point source. The nearest problem that NM has to the cumulative impact of a huge watershed to a large body of water is the potential, although not listed, nutrient concerns at Elephant Butte Reservoir. This is important when considering some of the studies and conclusions elsewhere about the cost/value of nutrient removal. A very small wastewater treatment plant (WWTP) (< 0.1 mgd) in a very large system (e.g., Chesapeake Bay) has different relative impacts to its system than the same size or smaller plant that is discharging to a smaller stream. For example, the Mora WWTP (0.052 mgd) discharging to the Mora River has (in conjunction with other sources) adversely affected its receiving water in part because the effluent dominates the stream (critical dilution = 93%). It is also interesting to note that much of the debate against and/or concern about implementing technology-based nutrient effluent limitations on a wide scale is based on concern about the general expense and therefore nutrient limitations should only be considered through water quality based permitting. In NM, this is contrasted by the fact that it is water quality based permitting, and the cost of trying to achieve very stringent, ecoregion-based, in-stream targets that have driven us to consider a technology-based approach to implementing TMDLs, especially for waters with NPDES permits.

Nutrient removal is one of the most pressing challenges facing wastewater treatment facilities today. Several technologies for nutrient removal exist. Phosphorus and nitrogen can be removed from wastewater via biological, chemical, or combined biological and chemical processes.

There are theoretical limits for the lowest levels that can be achieved with different removal mechanisms. The limit of technology, based on annual averages, is generally considered to be 0.1 mg/L for total phosphorus (TP) and 3.0 mg/L for total nitrogen (TN) (Jeyanayagam 2005). TP concentrations in treated effluent typically range from 0.1 to 1.0 mg/L, whereas TN concentrations typically range from 3.0 to 10.0 mg/L, depending on the removal process and site-specific conditions. The choice of technology to be used as well as the option and use of seasonal limits depend on the site-specific conditions, such as temperature, dissolved oxygen levels, and pH in combination with the economic feasibility.

The National Pollutant Discharge Elimination System (NPDES) permit program in New Mexico is administered by the United States Environmental Protection Agency (EPA). Section 401 of the Clean Water Act requires "state certification" of permits issued by a federal agency under the Act. Section 401 further requires the State to have procedures to certify the federally issued permits. The purpose of such certification is to reasonably ensure that the permitted activities will be conducted in a manner that will comply with applicable water quality standards, including the antidegradation policy and the statewide water quality management plan. The New Mexico Water Quality Act assigns the responsibility of State certification to the Environment Department.

The permit limits for phosphorus and nitrogen discharged from WWTPs, factories, food processors, and other dischargers can be appropriately adjusted and enforced in accordance with the nutrient impairment thresholds. Currently, New Mexico is employing a phased approach for setting nutrient permit limits (**Figure 6**). In recent nutrient TMDLs, the State has recommended, and EPA Region 6 has to date assigned, permit limits based on the limits of technology (**Table 10**) as opposed to stringent, technologically unachievable limits based on the water quality goals defined in the TMDL. To meet these limits, and depending on any unique situations, EPA R6 may allow for longer compliance schedules including multiple permit cycles. In addition the implementation section of recent nutrient TMDLs for New Mexico (**Table 9**) have also considered seasonal effluent limits to reduce or eliminate nutrient inputs during the growing season including zero discharge and/or land application practices (i.e., re-use) during certain times of the year, implementation as 30-day averages without a daily maximum value, and combinations thereof to meet the TMDL targets. The details of these and other implementation options are not discussed in this document.

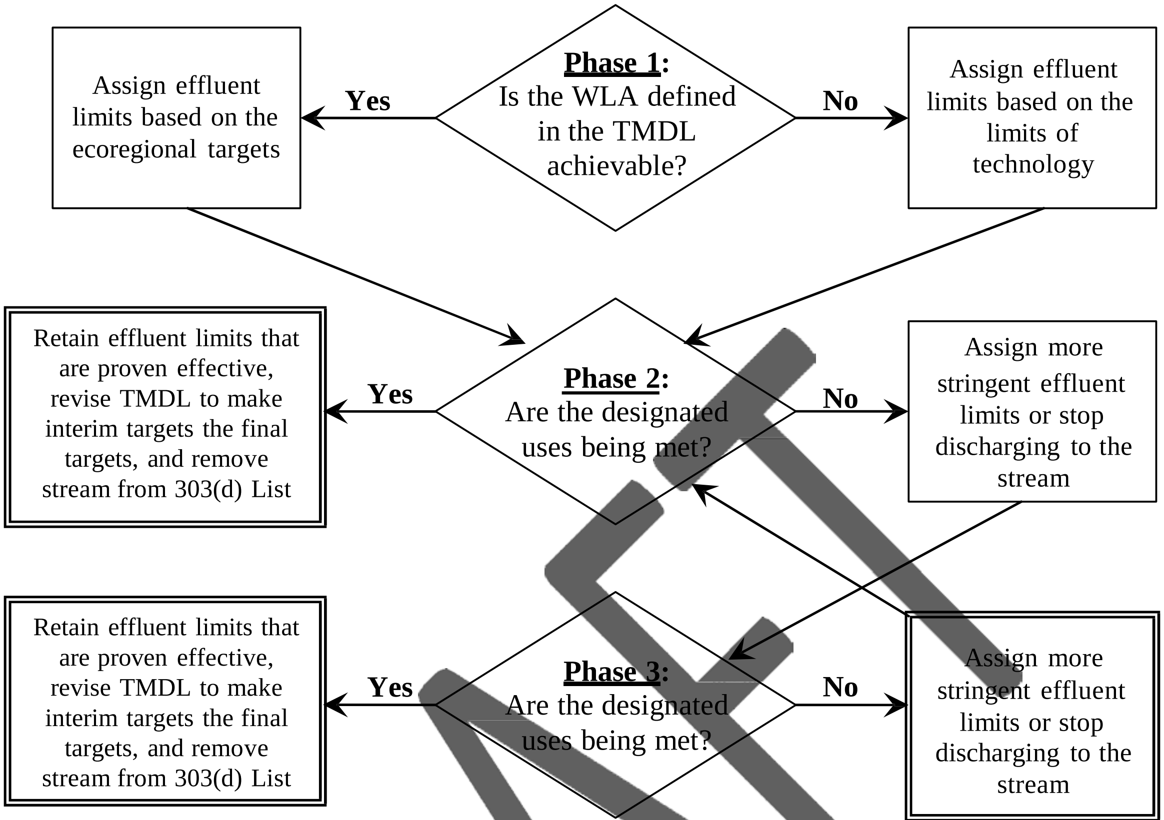

Figure 6. Decision process for assigning effluent limits in a phased TMDL

Table 10. Limit of Technology Approach to setting initial "**Phase 1"** effluent limits when water quality-based limits are unachievable.

WWTP	Nutrient effluent limits[a] (no more stringent than)
New facility[b]	TN = 3.0 mg/L and TP = 0.1 mg/L
Upgrade/expansion of existing facility or increase in design capacity[b]	TN = 3.0 mg/L and TP = 0.1 mg/L
Existing facility (no expansion/increase in design flow)	TN = 8.0 mg/L and TP = 1.0 mg/L

[a] Effluent limits are annual averages that are designed to help communities begin the process of converting their WWTPs for nutrient removal. Literature indicates these limits are technologically achievable (Jeyanayagam 2005; Barnard 2006; NRDC 2007; USEPA 2007; USEPA 2008).

[a] Biological treatment is highly temperature dependent therefore the permit may need to consider seasonal targets based on WWTP design.

Phased implementation is an iterative process and will require future data collection and analysis to determine if the load reductions achieved using effluent limits that are based on alternative target concentrations actually lead to attainment of water quality standards. SWQB will continue to monitor and evaluate the water quality conditions in the watershed and the impact of the alternative permit limits after implementation. At that time, if the water body is still impaired and there is no substantial improvement observed in the water quality, the WWTP would be required to enhance the treatment of the effluent by adding more effective treatment or find other means of disposal. This approach is currently being tested in several watersheds where TMDLs were recently written and approved (4 permits with WLAs); the permits have not yet been issued because the current permits have not expired.

Requirements for Data Collection

Additional data will be collected to classify sites, develop and refine thresholds by linking them to impairment, identify data gaps, and re-evaluate water quality conditions after implementation of nutrient control measures.

Physical, Chemical, and Biological Measurement Variables

Rivers/Streams: Physicochemical parameters, TP, TN, chlorophyll *a*, periphyton (rivers only) and benthic macroinvertebrates will be concurrently monitored. Whenever possible this will include a multiple-day deployment of multi-parameter sondes set to take at least hourly readings to examine diel fluctuations in DO and pH. Classification variables such as ecoregion, stream order, geology, and aquatic life use will also be refined and re-examined. Future data analyses will utilize an effects-based approach, such as change-point and/or regression tree analysis, that more closely links water quality targets with attainment of specific designated uses.

Lakes, Reservoirs and Wetlands: Soluble Reactive Phosphate is thought by some to be more critical than TP because TP is tied to sediment and not biologically available. However, knowledge about rates of uptake processes is often needed to make SRP data meaningful and TP is used in Carlson Trophic State Index. TP, TN, chlorophyll *a*, phytoplankton, secchi depth, and depth profiles of physicochemical parameters will be concurrently monitored. Classification variables such as ecoregion, reservoir size, and elevation will also be refined and re-examined.

Other Considerations

Stakeholder Input and Public Participation

An opportunity for public review is required as part of SWQB's various processes. The following is a list of areas where stakeholder input and public participation is sought:

1. ***Assessment Protocols*** – Prior to development of the Integrated List (see #2), SWQB solicits public comment on the draft *Procedures for Assessing Water Quality Standards Attainment for the State of New Mexico CWA §303(d)/§305(b) Integrated Report* (also known as the "Assessment Protocols"). The Assessment Protocols explain how the

SWQB evaluates existing and readily available surface water quality data and other information to determine whether or not surface water quality standards are attained.

2. ***The biennial State of New Mexico CWA §303(d)/§305(b) Integrated List of Assessed Surface Waters (Integrated List)*** – The Integrated List identifies whether or not a particular surface water of the state is currently meeting its designated uses as detailed in the State of New Mexico Standards for Interstate and Intrastate Surface Waters (20.6.4 NMAC), through application of the Assessment Protocols. "Category 5" waters on the Integrated List specifically constitute the CWA §303(d) List of Impaired Waters.

3. ***Total Maximum Daily Loads (TMDLs)*** – A TMDL is a planning document that establishes specific goals designed to meet water quality standards in water bodies where pollutant limits are exceeded (i.e., "Category 5" waters). They include current pollution loadings, reduction estimates for pollutants, information on probable sources of pollution, and suggestions to restore or protect the health of the water body.

4. ***NPDES Permitting*** – The National Pollutant Discharge Elimination System (NPDES) permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States. Point sources are discrete conveyances such as pipes or man-made ditches. Industrial, municipal, and other facilities must obtain an NPDES permit if their discharges go directly to surface waters.

Following the close of the public comment period, the SWQB typically prepares the final draft document as amended and a response to comments. In the case of Assessment Protocols, the final document is reviewed by EPA Region 6 and used to draft the Integrated List. In the case of the Integrated List and TMDLs, the final draft document is presented to the NM Water Quality Control Commission (WQCC) for review and approval. The final draft document and response to comments are available to the public 10 days prior to the regularly scheduled WQCC meeting. The final document, as approved by the WQCC, is then submitted to the EPA Region 6 for approval. In the case of point source discharge permits, the NPDES permit program in New Mexico is administered by EPA Region 6; however the Clean Water Act requires "state certification" of permits issued by a federal agency under the Act. The purpose of state certification is to reasonably ensure that the permitted activities will be conducted in a manner that will comply with applicable water quality standards, including the antidegradation policy, and the statewide water quality management plan. SWQB accepts written comments regarding the draft permit during the public comment period and considers all comments timely received in its preparation of the State Certification or Denial.

RTAG Coordination

The SWQB has and will continue to participate in EPA's Regional Technical Assistance Group (RTAG). EPA's Region 6 office serves Arkansas, Louisiana, New Mexico, Oklahoma, Texas, and 66 Tribal Nations. RTAG meetings are held annually at EPA's regional headquarters in Dallas to bring together nutrient experts from federal, state, and tribal agencies. Recent efforts toward the development of numeric nutrient criteria, as well as the latest technical information available, is reviewed and discussed. New Mexico will continue to ask RTAG members to review and comment on any new or refined threshold values and monitoring and assessment protocols.

Scientific Review

New Mexico is fortunate to have a scientific community actively involved in various aspects of nutrient ecology. SWQB plans to make significant use of that expertise to review future nutrient threshold development efforts.

Other Issues

The most critical item to consider is availability of resources for monitoring, lab analysis, and data analysis. Only a small portion of this plan may be implemented without continued or additional funding from EPA.

Schedule

Nutrient threshold development is an iterative process and will require future data collection and analysis to evaluate impairment thresholds and attainment of designated uses. **Table 11** provides a general timeline for the activities outlined in this document. This schedule will be reviewed and adjusted annually with input from EPA. If there is a need to deviate from the plan, EPA will be notified.

Table 11. General timeline for activities outlined in this document.

Milestone	Rivers and Streams		Lakes and Reservoirs		Wetlands	
	TP	TN	TP	TN	TP	TN
Planning for criteria development	*Nutrient Criteria Development Plan* for all water body types first drafted in **2004**. Revised in **2005**, **2006**, and **2008**. This document was used, in part, in **2012** for the *State of New Mexico Nutrient Reduction Strategy* (this plan). **Revisit/Revise, as needed, every 2 years.**					
Collection of information and data	Data collection is **on-going**; initiated in **2004** with support from three CWA §104(b)(3) grants. *Historical and current datasets combined in 2007 for streams and 2009 for rivers.*		*Historical and current datasets combined in 2009 for lakes/reservoirs.*		Data collection for wetlands started in **2011** in the Upper Rio Grande; Upper Canadian Watershed is planned in **2013**; Data collection is **on-going**	
Analysis of information and data	Streams = **2004** and **2007**; Rivers = **2011**. Further analysis and refinement of thresholds is planned for **2013-2014**.		Lakes = **2009** and **2011**. Further analysis and refinement of thresholds is planned for **2012**.		It is a goal of the SWQB to complete all elements required for a monitoring and assessment program for wetlands by **2016**.	
Proposal of criteria	No date planned	No date planned	No date planned	No date planned	No date planned	No date planned
Adoption of criteria (EPA-Approved)	No date planned	No date planned	No date planned	No date planned	No date planned	No date planned

TN: Total Nitrogen; **TP:** Total Phosphorus

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